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STARCH MATRIX MATERIAL CONTAINING IMBEDDED MATERIAL AND PROCESS FOR PREPARING SAME

Thomas J. Schoch, La Grange, and Charles C. Spencer, La Grange Park, Ill., assignors to Corn Products Refining Company, New York, N. Y., a corporation of New Jersey

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This invention relates to a method of dispersing various materials, and more particularly water-insoluble materials, in solutions of specific starches or derivatives thereof, and then drying the resultant dispersions in order to produce new and novel dry products in which the dispersed phase is imbedded in a starchy matrix and is protected from air oxidation, chemical changes, evaporation, and the like.

There is frequent need to protect liquid and solid substances, for example, to avoid toxic contact with the skin, or to prevent deterioration such as may be caused by air oxidation or evaporation. As one instance of such changes, it is not generally practicable to supplement poultry feeds by spraying the latter with beta-carotene concentrates, since the useful carotene pigment is rapidly bleached out by subsequent exposure to air and to light. Similarly, the manufacturers of packaged desserts have found it necessary to enclose flavoring oils in a gelatin capsule to prevent loss of flavor or development of off-flavors. Another instance is the protection of vitamin A by elaborate processes of coating the vitamin with an air-impermeable film. One of the more common methods now in use emulsifies the vitamin A (either as an oil concentrate or as the melted acetate) in a warm solution of gelatin. This emulsion is in turn emulsified in a vegetable oil to give a polyphase dispersion, which is then allowed to cool below the gelation point of the gelatin. The spherical globules of the latter are then separated from the oil phase and dehydrated with alcohol, to give dry particles of gelatin containing imbedded spherules of the vitamin (U. S. Patents Nos. 2,183,084; 2,182,592; 2,183,053).

A multitude of other instances may be cited, and for many of these, it is not economically feasible to resort to such complex processing, as described above for vitamin A. There is need for a simple and inexpensive means of protecting such materials as insecticides, dry spices and spice oils, medicinals and diet supplements, fatty substances subject to rancidity changes, and the like.

It is an object of the present invention to provide a method whereby various materials may be protected against physical and chemical deterioration. It is a further object to provide a method for imbedding water-insoluble liquids or solids in a continuous starchy matrix, such that the liquid or solid is finely dispersed through and surrounded by the starchy matrix. Still a further object is to provide new products which are stable against physical or chemical changes. Yet another object is to provide a method for dispersing a liquid in a dry matrix such that the final product will be in a powdered free-flowing form. Other objects will appear hereinafter.

We have found a new and novel method to provide the necessary protection for liquids and solids against physical and chemical deterioration. For example, by means of our invention, we can provide a barrier against deterioration by atmospheric oxygen in the case of vitamin

A or its derivatives. The precursor of vitamin A in xanthophyll oil, for example, can be protected so it may be added to poultry feed without loss of the vitamin values.

By means of our invention, it is possible to dilute highly active medicinals, or mixtures of medicinals, to a safe and uniform dilution. Our method of dilution is advantageous over mere dry-blending with a diluent since each particle in our finished product represents a uniform dispersion of the medicinal in the starch used.

Our invention permits the packaging of liquid substances in dry form, such that the liquid is immobilized behind a barrier of starch substance to prevent bleeding or staining, or to hinder evaporation of volatile substances, or to provide a product which may be handled more conveniently than prior art products. For example, our invention may be used to produce free-flowing shortenings for bakery goods by enclosing the emulsified liquid oil or melted fat in a starchy matrix.

Another example of an application of our invention is in the insecticide field. A solid or liquid insecticide may be surrounded by a starchy matrix and reduced to powdered form. Such powder can be dusted on fields. Subsequent contact of the individual particle with rain or dew would partially dissolve or swell the starchy matrix, causing it to adhere to the plant.

Yet another application of our invention is for those uses where it is necessary to reconstitute a stable colloid by dissolution in water. For example, a cold-water paint can be made by uniformly dispersing an insoluble pigment in a suitable starchy matrix. This material will reconstitute with water to give a paint of a uniform shade.

Liquids and solids which are toxic to the skin may be imbedded in a starch matrix in accordance with our invention and thus be more readily handled. Also mutually reactive agents may be imbedded in separate starch matrices, the dried materials mixed and stored, chemical reaction taking place when the dry mixture is wetted with water. In fact, our invention is useful in protecting any material which is compatible with, i. e., is not adversely affected by, aqueous starch referred to hereinafter.

In general, the process of our invention comprises making a solution of a starchy material to be defined hereinafter, uniformly dispersing therein the material which it is desired to protect, and then drying the dispersion. Optionally a plasticizer may be used to produce a less friable dry product, and a surface-active agent may be used to assist dispersion when a liquid is being treated. In general, as contemplated in this invention, the mechanism of encasing a dispersed phase of a finely divided liquid or solid with an impervious film requires that the starchy material be of relatively high molecular weight, be molecularly dispersible in water, and have the ability to maintain dispersed material in stable suspension. Such a starchy material should likewise exhibit low retrogradation tendencies in solution, and the dried films therefrom should exhibit a certain mechanical strength and coherence. A starchy substance which separates as an insoluble phase from solution before or during drying of the film is not satisfactory, as will be apparent from the text which follows hereinafter. Finally, for practical reasons, the starchy substance should be capable of dissolving in water to give solutions of relatively high concentration.

More specifically, the starchy materials (including starch derivatives) satisfactory for purposes of the present invention are those which possess the following five properties:

(1) The starchy material should be capable of being dissolved by cooking to give a solution or dispersion in which the individual starchy molecules are substantially